5.—NAUTILOID CEPHALOPODS FROM THE DEVONIAN OF WESTERN AUSTRALIA.

BY

CURT TEICHERT.

Read 13th September, 1938; Published 7th July, 1939.

CONTENTS.

ABSTRACT.

A brief review of the Devonian of Western Australia is given and attention is called to the unique position of the goniatite fauna in the Upper Devonian which is geographically far removed from any goniatite fauna of similar age. Actinosiphonate cephalopods, formerly not known outside Europe and North America, are for the first time shown to occur in Australia. The significance of the structures in this group is discussed and a classification of the group suggested. In this connection the following new families have been established: Diestoceratidae, Oocerinidae, Karoceratidae, Archiacoceratidae, Ptenoceratidae, Nothoceratidae. Furthermore, the significance of stereoplasmatic deposits in the camerae of certain cephalopods is discussed and attention is called to certain difficulties in classifying members of the Stereoplasmoceratidae.

The descriptive part contains the description of a new genus *Wadeoceras* as well as the description of new species of *Galtoceras* and *Stereoplasmoceras*, and of *Conostichoceras hardmanni* (Etheridge).

INTRODUCTION.

According to our present state of knowledge, Upper Devonian and presumably also Middle Devonian strata are represented in Western Australia, where they are known in patches along a narrow belt indicated by the Napier, Oscar and Rough Ranges on the south-western border of the Kimberley District, the northern topographic unit of Western Australia. Middle and early Upper Devonian strata are known from several localities in coral- and brachiopod-bearing calcareous facies (*Rough Range series* of Wade, 1938). Among the most important fossils of this division are: *Actinostroma*, *Stromatoporella*, *Disphyllum depressum*, *D. virgatum*, *Alveolites tumida*, *Aulopora repens*, *Atrypa aspera*, *A. desquamata*, *Schizophoria striatula*, *Wilsonia cuboides*, *Pugnax pugnus* (Hosking 1933, Hill 1936). Higher stages of the Upper Devonian are represented by the *Mt. Pierre series* (Wade 1938), best known from the locality known as Mt. Pierre, where extensive collections of cephalopods, mainly goniatites, have been made.[1]

Cephalopods from Mt. Pierre were first mentioned by A. H. Foord, who, in 1890, briefly described poorly preserved specimens of "*Orthoceras*" and "*Goniatites.*" Gürich, in 1901 (p. 515) suggested an early Upper Devonian age of the goniatites described by Foord, comparing them with *Goniatites simplex* (= *Tornoceras*) and *Goniatites calculiformis* (= *Manticoceras*) respectively. A consideration of the brachiopods described by Foord in the same paper led Haug (1911, p. 711) to infer the presence of Upper Devonian in Western Australia. However, the first actual proof of the occurrence of strata of this age was furnished by Delépine (1935) after a more detailed examination of collections of goniatites made by Professor Clarke and Dr. Wade. Delépine described the following species: *Sporadoceras contiguum* (Münster), *Pseudoclymenia australis* sp. nov., *Tornoceras* ? sp. nov., and *Dimeroceras clarkei* sp. nov. On the evidence of these species he concluded that the age of the Mt. Pierre strata must be Fammenian, most probably equivalent to Oberdevonstufe III.

In 1937, Schindewolf (p. 183) claimed that *Pseudoclymenia australis* and *Tornoceras* ? sp. nov. should be referred to *Protornoceras* Dybczynski.

The Goniatite limestone of Mt. Pierre is of remarkable interest, because it is so far removed from any other goniatite occurrence of similar age. There are no goniatites in the Devonian of the Tasman Geosyncline of Eastern Australia, where corals and brachiopods, though with European affinities, are predominant. The few facts which are known about the Devonian of New Guinea (Feuilletau de Bruyn 1921, p. 98; Stehn 1927; Teichert 1928, p. 6-13) show that the development there is mainly arenaceous with brachiopods and lamellibranchs. Similar types of deposits are represented in Burma, in the Yunnan, and in Tonkin. In fact the only Devonian goniatite fauna in eastern and south-eastern Asia is a small *Manticoceras* assemblage in the Chinese province of Hunan (Sun 1935) which is older than the goniatite beds of Mt. Pierre, and the nearest localities of goniatite faunas of approximately the same age as that of Western Australia are to be found in the southern Urals.

The brachiopod and coral facies of the Western Australian Devonian is more in harmony with the general development of the Devonian in South-eastern Asia, New Guinea and Eastern Australia. The age of the Devonian fossils of South-West New Guinea could be determined as Middle to early Upper Devonian (Teichert 1928) which corresponds to the age of the coral-brachiopod facies of the Kimberleys, as well as to that of the marine part of the Devonian section in Eastern Australia. Here, the uppermost part of the Devonian is represented by fresh-water beds and marine Fammenian also seems to be absent from New Guinea.

On the following pages, nautiloids from Mt. Pierre will be discussed and described, and, in addition, nautiloids from two other localities, viz., Lennard River and Oscar Homestead.

A cephalopod from Barker Gorge, Napier Range, listed as *Orthoceras* by Hosking (1933, p. 69) is identical with *Michelinoceras* cf. *schlotheimi* (Steininger) from Mt. Pierre. The rock containing this and the associated

[1] For details concerning the distribution of the Devonian outcrops in the Kimberley district the reader is referred to the summary by Lucy Hosking (1933).

brachiopod specimens listed by Hosking is very similar to the Mt. Pierre limestone. It is, therefore, probable that the Mt. Pierre Series also crops out in the Napier Range, although it may be developed in brachiopod facies in this place. It would be an interesting subject of future research to establish the exact correlation between the brachiopod and the goniatite facies in the Upper Devonian of Western Australia.

The distribution and age of the fossils described in the last chapter of this paper is as follows:—

Michelinoceras cf. *schlotheimi* (Steininger) Fammenian. Barker Gorge, Napier Range, and Mt. Pierre.

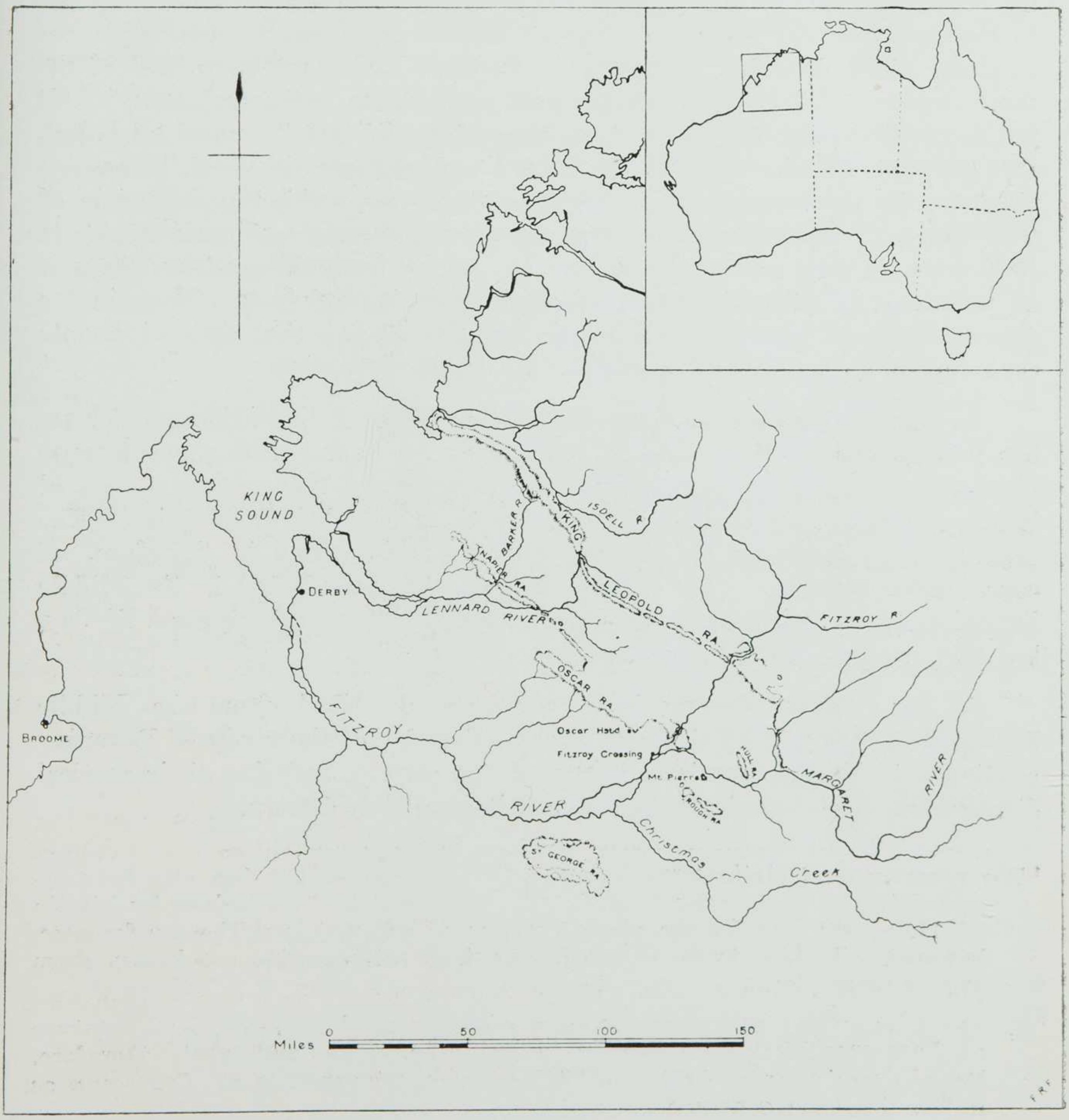
Stereoplasmoceras iniquiseptatum sp. nov. Probably Upper Devonian. Oscar Homestead, Oscar Range.

Wadeoceras australe gen. nov. et sp. nov. Fammenian. Mt. Pierre.

Conostichoceras hardmanni (Etheridge). Perhaps Middle Devonian. Lennard River, probably from the Napier Range.

Galtoceras kimberleyense sp. nov. Fammenian. Mt. Pierre.

The localities mentioned in the text can be found on the attached map (fig. 1).



OCCURRENCE OF CYRTOCEROIDEA (ACTINOSIPHONATE CEPHALOPODS) IN AUSTRALIA AND SUGGESTED CLASSIFICATION OF THIS GROUP.

Two of the species described in this paper, viz. *Wadeoceras australe* n. sp. and *Conostichoceras hardmanni* (Etheridge), belong to a group of cephalopods which is usually known as the actinosiphonate group and which so far has not been recorded from Australia. It is true that the cephalopod described by Etheridge in 1897, clearly shows the actinosiphonate structure, but its affinities were not recognised by that author and the specimen was described as an *Actinoceras*.[1]

Wadeoceras australe occurs in the Mt. Pierre limestone and is, therefore, presumably of the Fammenian age, whereas the specimen of *Conostichoceras* comes from an unknown locality on the Lennard River. Etheridge assigned a Carboniferous age to this latter specimen, but cephalopods of the actinosiphonate group can hardly be expected in rocks of that age. In his elaborate study of actinosiphonate cephalopods, published in 1926, A. F. Foerste (p. 288) stated that "the Actinosiphonata are known to range from the lower Upper Ordovician to the Upper Devonian. Possibly they occur in the Carboniferous, but the evidence is not clear." The latter statement refers to the structure of *Orthoceras breynii* Martin from the Carboniferous of England which, however, according to Foerste's statement on p. 290 of the same paper "is regarded as actinoceroid rather than actinosiphonate." All the facts concerning this species have been presented and discussed by Miller, Dunbar and Condra in 1933 (p. 54-57) and nothing in their discussion indicates the presence of actinosiphonate structures within the siphuncle of the holotype.[2] These authors have reproduced Martin's original figure of *Orthoceras breynii* and as far as can be judged from this picture, there is no indication of actinosiphonate lamellae within its siphuncle. Thus, in the present state of knowledge, it is only possible to say that actinosiphonate cephalopods do not range higher than the Upper Devonian.

In regard to the geographical distribution of the Actinosiphonata Foerste has pointed out (1926, p. 291-292) that they are found throughout Europe (including Novaya Zemlya) and in the eastern and mid-western states of North America. No species have so far been recorded from Asia. The occurrence in Australia of representatives of this group is, therefore, of considerable interest. The group may also be represented in the Middle Devonian of Victoria and Queensland by *Phragmoceras subtrigonum* McCoy, but this requires further corroboration.

So far, *Conostichoceras* had only been described from the Middle Devonian of Bohemia but it must be remembered that the study of Devonian nautiloids in Europe has been neglected for decades and that their vertical distribution, therefore, is probably very incompletely known.

---

[1] The occurrence of *Actinoceras* in rocks of post-Silurian age has also been reported in the Yunnan by Reed (1927, p. 16) and in New Guinea by Martin (1911, p. 93) and by the present writer (1928, p. 17). These references, however, will have to be changed. No true actinoceroids are known from any of these places.

[2] It should be noted that *Orthoceras breynii* Martin has been selected as genotype of *Loxoceras* McCoy by Bassler in 1915 (p. 767) and that, therefore, *Breynioceras* Foerste (1929, p. 284) is an exact synonym of *Loxoceras*, as it has the same genotype.

The specimen of *Conostichoceras hardmanni,* however may be derived from strata of Middle Devonian age. The Lennard River crosses the Napier Range, where outcrops of Devonian strata are known to occur. Hosking (1933, p. 68-69) mentions numerous brachiopods, *Proetus, Euomphalus,* and *Bellerophon* from two different localities in the Napier Range, and Hill (1937, p. 30) has described *Phillipsastraea delicatula* from Barker Gorge, Napier Range, a species closely related to the Upper Devonian *P. hennahi,* but the occurrence of Middle Devonian in this country is at least not contradicted by fossil evidence.

Cephalopods with an actinosiphonate structure of the siphuncle were grouped in a separate order, Cyrtoceroidea, by the present writer in 1933. Schindewolf (1935, p. 110), though recognising the validity of the group, would prefer to class it as a suborder of the Nautiloidea. Eighty species, belonging to 41 genera, were enumerated by Foerste in his "List of known Actinosiphonata" in 1926 (p. 303-304). Since then a number of additional species have been described by Troedsson, Heritsch, Strand, Flower, and the present writer, bringing the number up to the vicinity of hundred and extending the geographical range northward to Greenland. The Cyrtoceroidea as defined by the present writer include orthoconic, cyrtoceraconic and coiled conchs in a great variety of forms, comparable to the variety in other cephalopod groups.

Foerste has called attention to the difficulty in classifying certain forms which are very similar to actinosiphonate genera, but in which no endosiphuncular structures are known. Until more is known of these forms, they are better excluded from the Cyrtoceroidea. If only genera in which actinosiphonate structure is known to occur, are considered, the following classification can be suggested:—

Family Jovellanidae Foord. Orthoconic conchs.

Laumontoceras Foerste, *Jovellania* Bayle, *Mixosiphonoceras* Hyatt, *Tripleuroceras* Hyatt, *Projovellania* Hyatt.

Family Diestoceratidae nov. Brevicones, either straight or slightly curved.

Diestoceras Foerste, *Wetherbyoceras* Foerste, *Herkimeroceras* Foerste, *Pachtoceras* Foerste.

Family Oocerinidae nov. Longiconic cyrtoceracones.

Oocerina Foerste, *Blakeoceras* Foerste, *Perimeroceras* Foerste.

Family Karoceratidae nov. Exogastric cyrtoceracones without constricted aperture.

Karoceras Roussanoff, *Wissenbachia* Foerste, *Conostichoceras* Foerste, *Turnoceras* Foerste, *Poterioceerina* Foerste, *Minganoceras* Foerste, *Eleusoceras* Flower. (

Family Cyrtoceratidae Chapman. Exogastric cyrtoceracones with constricted aperture.

Cyrtoceratites Goldfuss,[1] *Amphicyrtoceras* Foerste, *Paracleistoceras* Foerste, *Acleistoceras* Hyatt, *Brevicoceras* Flower, and perhaps *Cyrtactinoceras* Hyatt.

[1] This genus is usually referred to as "*Cyrtoceras* Goldfuss" and credited to this author as a manuscript name first published in de la Beche's "Handbuch der Geognosie" in 1832 (p. 536). Actually, however, the name was written *Cyrtocera* in this publication, but it is preceded by *Cyrtoceratites* Goldfuss which was published as a manuscript name by F. Hoeninghaus in 1830 (p. 228). Goldfuss himself used still another spelling in 1832 (p. 483), viz., *Cyrthoceratites.* The name *Cyrtoceras* was first used by Sowerby in 1839 (p. 621) in connection with a gastropod ("*Cyrtoceras laeve*").

Family Archiacoceratidae nov. Endogastric cyrtoceracones.

Endoplectoceras Foerste, *Archiacoceras* Foerste,[1] *Danaoceras* Foerste, *Codoceras* Hyatt, *Coelocyrtoceras* Foerste, *Wadeoceras* nov. gen. Perhaps also *Protophragmoceras* Foerste.

Family Phragmoceratidae Hyatt. Phragmoceroid conchs, mostly endogastric, aperture with dorsal or lateral sinuses.

Phragmoceras Broderip, *Bolloceras* Foerste, *Tubiferoceras* Hedström, *Mandaloceras* Hyatt, *Hemiphragmoceras* Hyatt, *Tetrameroceras* Hyatt, *Conradoceras* Foerste, *Paraconradoceras* Foerste, *Hexameroceras* Hyatt, *Octameroceras* Hyatt, *Metaphragmoceras* Flower.

Family Ptenoceratidae nov. Trochoceroid conchs.

Ptenoceras Hyatt, *Adelphoceras* Barrande, *Homoadelphoceras* Foerste.

Family Nothoceratidae nov. Nautiloid conchs.

Lorieroceras Foerste, *Nothoceras* Barrande.

REMARKS ON THE STEREOPLASMOCERATIDAE.

One of the Western Australian forms has been described below as *Stereoplasmoceras iniquiseptatum* and, since the group to which this species belongs, has been recently discussed by Kobayashi (1936), a few remarks considering this group may be appropriate. It is now generally recognised by most authors that stereoplasmatic deposits exist in the camerae of many nautiloid cephalopods, especially in orthoceraconic forms. Observations on these deposits were first made and communicated by Barrande in 1859. Since then, numerous authors, including Dewitz, J. Hall, H. Schröder, G. Holm, Graubau, and Miller, Dunbar and Condra, have discussed these structures and the present writer, in 1933, has given a full account of intracameral deposits in actinoceroid cephalopods and also discussed their presence in certain non-actinoceroid forms. As far as the origin of these deposits is concerned, most authors seemed to adhere to Barrande's original view that they were formed after the formation of the septum to which they belong, and before the formation of the next succeeding septum. An alternative explanation had been to assume that the material for the intracameral deposits had been supplied by the siphuncle through foramina in the connecting ring. The first idea does not account for the formation of hyposeptal deposits and for the regularity of increase in thickness of the deposits in many forms; the second idea was disproved by the fact that

[1] It could perhaps be argued whether the name *Phragmoceratites* d'Archiac and de Verneuil should not take precedence over *Archiacoceras* Foerste. D'Archiac and de Verneuil, when establishing *Phragmoceratites subventricosus* in 1842 (p. 351), were the first authors to use the generic name *Phragmoceratites*. However, from their text it is quite evident that they did not want to establish *Phragmoceratites* as a generic name, but merely wanted it to replace *Phragmoceras* Broderip. Since Art. 25 of the International Rules provides that none of the earlier names should be available unless it is "accompanied by an indication, or a definition, or a description," I do not think that d'Archiac and de Verneuil established a genus "*Phragmoceratites*," even if, as it appears to be the case, *subventricosus* is the only species ever described in connection with this generic name. Because *Phragmoceratites* has only been substituted for *Phragmoceras*, the genotype of the latter becomes automatically the genotype of the former, and that name must be suppressed as a synonym.

the connecting ring is not perforated by macroscopical openings and it was shown by the present writer in 1933 that the material necessary for the formation of intracameral deposits must have permeated through the connecting ring in some other way.[1]

There is no doubt that the Stereoplasmaceratidae[2] which, as defined by Kobayashi in 1936, include genera with intracameral stereoplasmatic deposits either with or without an endosiphuncular stereoplasmatic tube, are members of an important group of cephalopods and may even have higher than family rank. However, in spite of the importance which on account of their wide distribution, must be attached to the presence of these intracameral deposits, it is still necessary to take great care in the grouping of forms with these characters. In 1933, the writer asked the question, what taxonomic importance should be attributed to the presence of intracameral deposits. To-day, the question would be better put by asking, what taxonomic importance should be attributed to the *absence* of these deposits. Kobayashi does not discuss the significance of the fact that we find species with intracameral deposits and species without such deposits belonging to one and the same genus of actinoceroids. In the case of actinoceroid cephalopods we have criteria other than intracameral deposits to ascertain the generic affinities of species, but in cephalopods lacking distinctive features of the siphuncle, it becomes almost impossible to tell how species agreeing with stereoplasmoceroids in all other respects should be classified if they lack intracameral deposits. Evidently, the absence of these deposits might be just as accidental and insignificant in stenosiphonate forms as it can be in actinoceroids, and although their presence must be regarded as of considerable biological interest, the taxonomic significance of their absence in certain cephalopods is still far from being sufficiently understood.

Stereoplasmoceras iniquiseptatum, described below, represents a development of stereoplasmoceroids which is characterised by small "obstruction rings," better called bullettes, in the vicinity of the septal necks. The combination of bullettes with intracameral deposits is characteristic of many cephalopods and is also found in orthochoanitic forms with cylindrical segments of the siphuncle. As an example, a specimen can be mentioned which was described as "*Orthoceras* n. sp." by the present writer in 1933 (p. 182). Very similar types are numerous in the Silurian and Devonian of Bohemia, e.g. *Orthoceras jonesi* (Barrande 1859, pl. 18, fig. 13). Among the species with slightly inflated segments the Devonian *Orthoceras concors* and the Silurian *Orthoceras vibrayei* may be mentioned (Barrande 1859, pl. 18, figs. 6 and 9).[3]

---

[1] Kobayashi, in 1936 (p. 231), erroneously ascribed to the writer the view that "the pseudosepta or the junction of the deposits from both sides of the camera, is naturally united with the opening of the diverticula." The writer, on the contrary, has devoted many pages to an attempt to prove that the "diverticula" or radial canals of the siphuncle are not in open communication with the camerae, but open into the perispatia, that the connecting ring is not perforated by foramina, and that the "pseudoseptum" is not an organic structure at all, but the contact surface between episeptal and hyposeptal deposits.

[2] The genus *Pseudorthoceras* Girty which was included in the *Stereoplasmoceratidae* by Kobayashi in 1936, constitutes, together with related Late Palaeozoic genera, the family Pseudorthoceratidae Flower and Caster.

[3] Many more examples could be quoted from Barrande's "Système Silurien," but unfortunately this work is not available in Western Australia.

All these forms have essentially the same structure, viz., small bullettes in the siphuncle and intracameral deposits, and should be grouped together in spite of the differences in the shape of the segments and in the structure of the septal neck. It is obvious that this group is not related to the actinoceroids, because in the latter the "stereoplasmatic deposits" within the siphuncle originate by a process of progressive calcification of an originally soft, endosiphuncular tissue in which the endosiphuncular vascular system is embedded.

DESCRIPTION OF THE SPECIES.

FAMILY **ORTHOCEROTIDAE.**

Genus **MICHELINOCERAS** Foerste.

Michelinoceras cf. **M. schlotheimi** (Steininger).

1890—Orthoceras sp. A. H. Foord, Geol. Mag., dec. III., vol. 7, p. 6, plate 4, fig. 3.

The Red Goniatite limestone of Mt. Pierre contains numerous specimens of a species of long orthoconic, slowly tapering conchs of orthoceroid cephalopods which, however, are not sufficiently well preserved for accurate description. The cross-section of the conchs is circular and the small, cylindrical siphuncle is central. The distance between the septa equals about 4/10 to ½ the diameter of the camerae. The length of full-grown specimens must have been something like 20 cm., almost half of which was occupied by the living chamber which was at least eight times as long as it was wide at its base. The rate of tapering is about 1 : 15.

The species known as *Orthoceras schlotheime* from the Frasnian (Zone 8) of Saltern Cove in England and from the Büdesheimer Schiefer of Germany (see Anniss, 1928) seems to be rather close to the Mt. Pierre form. Foord (1888, p. 97-98) described this species as "straight, extremely slender, cylindrical, very slowly tapering. Length of body-Chamber at least eight times the diameter of its base. Septa distant from about ½ to ⅗ the diameter." As long as no well-preserved internal moulds as well as traces of the test are known from Mr. Pierre, exact determination of the species will be impossible.

The same species apparently occurs also in the red limestone of the Barker Gorge, Napier Range.

FAMILY **MAELONOCERATIDAE** HYATT.

Genus **GALTOCERAS** Foerste.

Galtoceras kimberleyense sp nov.

Plate I., figs. 4, 5.

Diagnosis: Species differing from other members of the genus in the more rapid expansion of the phragmocone.

Description of holotype: The holotype and only known specimen is a portion of a moderately curved exogastric phragmocone; its dorso-ventral diameter at the adapical end is 10 mm., the lateral diameter 12 mm. At the adoral end the dorso-ventral diameter is 20 mm., whereas the lateral diameter cannot be accurately determined. The length of the camerae increases from 2 mm. at the adapica end to 2.8 mm. at the adoral end of the specimen. The sutures are straight and directly transverse to the curving longitudinal axis of the conch. The siphuncle is close to the convex side of the conch. The segments are narrow and cylindrical, being only slightly constricted at the septal foramina.

Locality: Mt. Pierre, Western Kimberley District, Western Australia. No. 116 Commonwealth Palaeontological Collection, Canberra.

Remarks: The state of preservation of this specimen is rather poor, no trace of the shell being preserved. In *Galtoceras* the shell is finely striated transversely and in the holotype of *Galtoceras arcticameratum* Clarke and Ruedemann, kept in the New York State Museum, Albany, N.Y., the writer observed very shallow longitudinal ribs, when he had an opportunity of studying this specimen in 1930. Only Silurian species of Galtoceras are known so far, but the Australian species is referred to this genus on account of the slight curvature of the conch and the straight sutures which distinguish this genus from nearly related genera as e.g. *Cyrtorizoceras*.

The specimen has previously been figured by A. Wade in 1924 (p. 44, plate III.) and has been listed as *Geisonoceras* sp. by F. Chapman (p. 7 of undated pamphlet; see bibliography).

Cyrtoceras cornu-copiae Sandberger and *Cyrtoceras bilineatum* Sandberger from the German Devonian may be related species, but so far too little is known about their structure (see Sandberger 1855, plate 13, fig. 4 and plate 14, fig. 2).

Family **ARCHIACOCERATIDAE** nov.

Genus **WADEOCERAS** gen. nov.

Genotype: **Wadeoceras australe** sp. nov.

Slightly compressed, endogastric cyrtoceracones with actinosiphonate siphuncle. The segments of the siphuncles are wider than long, but not inflated between the septa.

This genus is very similar externally to *Danaoceras* Foerste as well as to *Archiacoceras* Foerste. In the former genus, however, which is known from the Middle Silurian of Bohemia the siphuncle is very narrow and cylindrical, whereas in the latter genus, known from the Middle Devonian of the Eifel, Germany, the siphuncle is broadly nummuloidal (Foerste, 1929, p. 295).

Phragmoceras subtrigonum from the Middle Devonian of Victoria and Queensland may belong to this genus or to *Archiacoceras*. In his description of this species McCoy (1876, p. 18) mentioned its similarity to *Phragmoceras subventricosum* d'Archiac and de Verneuil which is the genotype of *Archiacoceras*, but the structure of the siphuncle of *Phragmoceras subtrigonum* is still unknown.

Wadeoceras australe sp. nov.

Plate I., figs. 2, 3. Text-fig. 1.

Diagnosis: Slightly compressed endogastric cyrtoceracone, with actinosiphonate structure of siphuncle.

Description: The holotype and only specimen known is a portion of a phragmocone, 57 mm. long. It increases rapidly in diameter, the cross-section being compressed laterally. At the adapical end the dorso-ventral diameter is about 32 mm., the lateral diameter about 24 mm. At a distance of 40 mm. from the adapical end the dorso-ventral diameter is 51 mm., whereas the lateral diameter is 45.5 mm. The outline of the dorsal side of the phragmocone is slightly convex, whereas the ventral side which is not very well preserved seems to be almost straight, although a median longitudinal section reveals a slight curvature of the siphuncle in the adapical part of the specimen, so that the conch had a slightly concave outline along the posterior part of the ventral side.

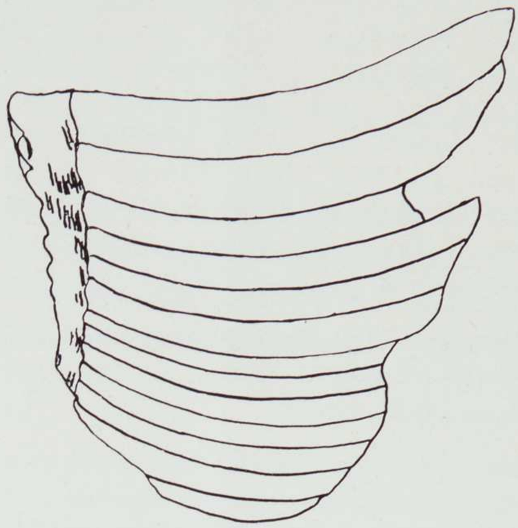


Fig. 1.—Dorso-ventral section of holotype of *Wadeoceras australe*. Nat. size.

The sutures rise dorsally and, owing to the curvature of the dorsal side, the distance between two sutures in the middle part of the specimen increases from 2 mm. on the ventral side to 5 mm. on the dorsal side. The septa are rather deeply concave, being 6 to 7 mm. deep.

The siphuncle is very probably not more than 1 or 2 mm. from the wall of the conch. The septal necks are cyrtochoanitic on the ventral side and orthochoanitic on the dorsal side. The width of the septal foramen increases from 2.5 mm. in the adapical part to 6 mm. in the adoral part of the specimen. A peculiarity of the segments of the siphuncle is their lack of symmetry. In the dorso-ventral section the ventral outline is convex, whereas the dorsal outline is concave. The curvature of the outlines on both sides is approximately equal and the width of the segments, therefore, is approximately equal to the width of the corresponding septal foramina. In the interior of the siphuncle there are numerous radiating lamellae which apparently are not continuous, but are restricted to the neighbourhood of the septal necks.

Locality: Mt. Pierre, Western Kimberley District, Western Australia. No. 117 Commonwealth Palaeontological Collection, Canberra.

Remarks: This specimen has been previously figured by A. Wade in 1924 (p. 42, plates II. and III.) and has been listed as *Rizoceras* sp. by Chapman (p. 7 of undated pamphlet; see bibliography).

FAMILY **KAROCERATIDAE** NOV.

Genus **CONOSTICHOCERAS** Foerste.

Conostichoceras hardmanni (Etheridge).

Plate I., fig. 1; Plate II., figs. 7, 8.

1897—*Actinoceras hardmanni*, R. Etheridge, Actinoc. N.-W. Australia, p. 7-9, pl. III.

Description: The holotype and only known specimen represents a portion of an exogastric phragmocone, being 155 mm. long and elliptical in cross-section. At the adapical end of the specimen the lateral diameter is

53 mm., whereas the dorso-ventral diameter is 37 mm. in the middle of the specimen the corresponding figures are 87 mm. and 49 mm. The lateral diameter at the adoral end of the specimen is 107 mm. It is, however, obvious that the specimen in its present state of preservation is more depressed than it was in its original state. It can be seen in transverse and longitudinal sections that the septa are crushed, but it is not possible to state the exact amount of secondary compression the specimen has suffered. However, because the ventral side is broadly and evenly rounded, whereas the lateral sides are narrowly rounded, it can be said that the phragmocone, at least in its posterior part, has had a rather broadly elliptical cross-section. The longitudinal outline of the ventral side of the specimen is evenly convex. Owing to the partial destruction of the dorsal side, it cannot be stated with certainty whether this was convex, straight, or concave; the latter, however, is the most probable. In the adoral part of the specimen the surface of the mould is distinctly elevated along a median longitudinal zone, where the siphuncle is situated. This elevation which is not visible in the adapical portion of the phragmocone is, however, probably due to resistance offered by the siphuncle when the specimen was compressed dorso-ventrally during fossilization.

The distance between two successive septa increases from 5 mm. in the adapical to 8 mm. in the adoral part of the specimen when measured along the ventral side. The sutures in the adapical part are straight, but in the adoral part they cross the ventral side in broad arches, the ventral lobes being 13 mm. high.

The siphuncle is situated 5 to 6 mm. from the ventral wall of the conch. Its actinosiphonate structure has been clearly illustrated by Etheridge. Between the radiating lamellae the lumen of the siphuncle is filled with limestone matrix, whereas the camerae are filled by infiltrated crystalline calcite. The cross-section of the siphuncle, reproduced on Plate II., Fig. 8 of this paper is taken approximately in the middle of the specimen, where the width of the siphuncle is 9.2 mm. laterally and 7.5 mm. dorsoventrally. In this section there are 19 septa-like lamellae of varying length,

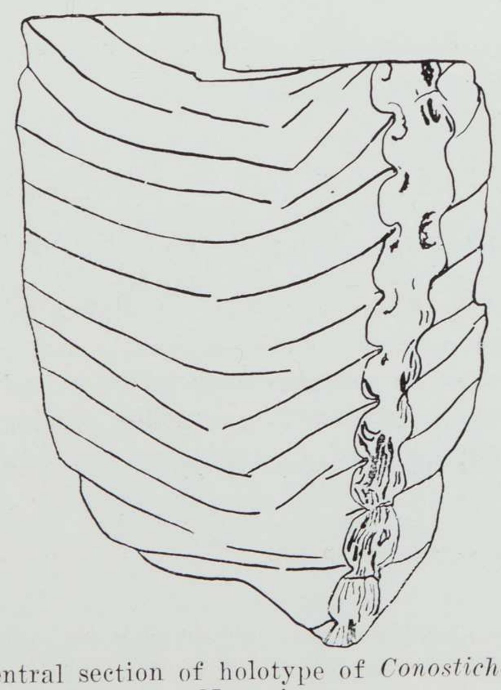


Fig. 2.—Dorsoventral section of holotype of *Conostichoceras hardmanni*. Nat. size.

radiating from the periphery of the segment towards the centre. Some of the lamellae are slightly thickened at their interior terminations. As Etheridge correctly observed, some of the lamellae appear to be folds of the connecting ring. In others this is not so clearly visible—they simply seem to be processes extending from the inner side of the connecting ring. Colour and state of preservation of these lamellae is apparently the same as that of the connecting ring and it may be concluded that the lamellae consisted of a substance similar to that of the connecting ring. This possibility has already been suggested by the present writer after a study of Ordovician actinosiphonate *Diestoceras* (Teichert 1934, p. 45).

The shape of the segments of the siphuncle is somewhat irregular. The septal necks are orthochoanitic and long on the ventral side of the septal foramen, strongly cyrtochoanitic and much shorter on the dorsal side. Together with the similar though reversed conditions in *Wadeoceras australe* this affords additional examples of the variability of septal necks in one and the same specimen and for the unreliability of the shape of the septal neck as a criterion in classification.

As a rule, the ventral wall of the segments of the siphuncle is approximately straight or only slightly convex and vertical to the septa, forming the continuation of the straight septal neck. In the adapical part of the specimen this side of the wall of the segments is in contact with the adoral surface of the septa, the width of the adnation surface varying between 1 and 2 mm. On the dorsal side the segmental wall usually expands rapidly. In the adapical part of the specimen this dorsal side of the segments is slightly concave in the vicinity of the septal neck, then becomes convex, reaching the maximum convexity in the posterior third of the segment. Near the adapical septum the wall is strongly recurved and there is no adnation surface, the wall joining the septum at the septal foramen. As a rule, the segments have their maximum width in the posterior part. Lateral sections are available of two segments only. The septal neck in the lateral section apparently is still cyrtochoantic, though with a much less recurved brim than on the dorsal side of the foramen. Of the two segments one has the greatest width behind the middle, whereas in the other the wall is evenly convex.

Locality: Leonard River, Western Kimberley District, Western Australia. No. F.4600 Australian Museum, Sydney.

Remarks: This species agrees sufficiently well with *Cyrtoceras palinurus* Barrande, the genotype of *Conostichoceras* Foerste, to be included in this genus. It resembles the genotype in the general shape of the conch F, the position and size of the siphuncle and in, although in the holotype of *C. Palinurus* (reproduced by Foerste, 1926, plate 38, figs. 1A, 1B) a large part of the conch is occupied by the living chamber. It differs in the somewhat more irregular shape of the segments of the siphuncle and in lacking the slight concavity of the dorsal outline of the conch in the adoral part, and probably also in the smaller number of radiating lamellae within the siphuncle. The lateral view of the siphuncle of *C. palinurus*, as published by Barrande, shows that the segments of siphuncle of this species in a lateral section are much wider posteriorly than anteriorly and that they are adnate to the adoral surface of the posterior septum.

When he established the genus *Conostichoceras*, Foerste (1926, p. 341) called attention to the actinoceroid appearance of the segments of the siphuncle—a fact which is also apparent in *Conostichoceras hardmanni* and which misled Etheridge in referring this species to *Actinoceras*.

FAMILY STEREOPLASMOCERATIDAE KOBAYASHI.

Genus STEREOPLASMOCERAS Grabau.

Stereoplasmoceras iniquiseptatum sp. nov.

Plate I., fig. 6.

Description: The holotype is a portion of an internal mould of a phragmocone, 60.5 mm. long, approximately circular in cross-section with a diameter increasing from 26.5 to 32.5 mm. Externally the specimen is strongly weathered, but the internal structures are well preserved. There are ten camerae which are peculiar by their unequal length. The lengths of the camerae, starting with the posterior camera, are: 5.2, 4.5, 5.0, 8.3, 6.6, 6.1, 6.5, 6.1 and 7.8 mm. This is a very remarkable deviation from the constant increase in length of the camerae which is usually so characteristic of cephalopods of any group. The septa are moderately concave, being about 7 mm. deep. There are episeptal deposits as well as hyposeptal deposits within the camerae. These are more strongly developed on one side than on the other, probably indicating ventral and dorsal side of the specimen respectively. On neither side do the deposits extend to the siphuncle, but cover only part of the surface of the septa. The septal necks are cyrtochoanitic and between 0.7 and 1.0 mm. long. The brim is directed obliquely backward.

The siphuncle is central. Notwithstanding the difference in length of the segments (corresponding to the length of the camerae), all of them are inflated between the septa to the same width of 6.0 to 6.5 mm. Thus, the shorter segments have a more globular, the longer segments a more fusiform appearance. The septal foramina have a width of about 2.5 mm., but at the passage through the foramina the siphuncle is further constricted by small bullettes which extend around the septal necks. These bullettes are thinnest in the septal foramen, they expand slightly adorally as well as adapically. The remainder of the siphuncle has been empty, at least no traces of any other primary structures can be seen.

Locality: Near Oscar Homestead, south-eastern end of Oscar Range, western Kimberley District, Western Australia associated with *Spirifer verneuili*, an Upper Devonian species. No. 15702 Dept. of Geology, University of Western Australia.

Remarks: The remarkable inequality of the length of the camerae which has been mentioned above, is rarely found in Cephalopods. A specimen showing similar conditions has been figured by Kobayashi (1934, plate 24, fig. 1) as *Stereoplasmoceras tofangioides*. The following measurements for the length of 5 consecutive camerae have been taken from that figure: 7.3, 9.5, 7.0, 8.2, 8.2 mm. This specimen comes from the Middle Ordovician of Korea. It is not yet known, whether the changes in length of the camerae are a constant feature of certain species or an abnormal condition in individual specimens.

ACKNOWLEDGMENTS.

The writer is indebted to Dr. C. Anderson of the Australian Museum, Sydney, and to Miss Irene Crespin, Commonwealth Palaeontologist, Canberra, who kindly placed specimens at his disposal. He also wishes to thank Miss K. L. Prendergast, Cambridge, who furnished information about the locality and associated fossils of one of the specimens. Sincere thanks are due to Mr. F. Feldtman who very kindly drew the accompanying map of the localities and to Professor E. de C. Clarke for his help during the writing of the paper.

BIBLIOGRAPHY.

Anniss, L. G.; The Geology of the Saltern Cove Area, Torbay. *Qu. J. Geol. Soc. London*, vol. 83, 1928, p. 492-500.

D'Archiac and E. de Verneuil: On the Fossils of the Older Deposits in the Rhenish Provinces. *Trans. Geol. Soc. London*, 2nd ser., vol. VI., pt. 2, Art. XXV., London, 1842.

Barrande, J.: Dépôt organique dans les loges aériennes des Orthocères. *Bull. Soc. géol. France*, ser. 2, vol. 16, Paris, 1859, p. 828-855.

Bassler, R. S.: Bibliographic Index of American Ordovician and Silurian Fossils. *U.S. National Mus.*, Bull. 92, Washington, 1915.

Beche, T. de la: Handbuch der Geognosie. Bearbeitet von H. von Dechen, Berlin, 1832.

Chapman, F.: The Wade Collection of Fossils. (Undated pamphlet), Melbourne.

Delépine, G.: Upper Devonian Goniatites from Mount Pierre, Kimberley District, Western Australia. *Qu. J. Geol. Soc.* London, vol. 91, 1935, p. 208-215.

Etheridge, R.: An Actinoceras from North-West Australia. *Rec. Austral. Mus.*, vol. 3, Sydney, 1897, p. 7-9.

Feuilletau de Bruyn, W. K. H.: Contribution à la Géologie de la Nouvelle-Guinée. *Bull. Lab. Géol., Géogr. phys., Min. et Pal. Univ. Lausanne*, No. 30, Lausanne, 1921.

Foerste, A. F.: Actinosiphonate, Trochoceroid and Other Cephalopods. Denison Univ. Bull., *Jour. Scient. Lab.*, vol. 21, Granville, Ohio, 1926, p. 285-434.

——————- Three Studies of Cephalopods. *Ibid.*, vol. 24, 1929, p. 265-381.

—————— Silurian Cyrtoconic Cephalopods from Ohio, Ontario, and Other Areas. *Ibid.*, vol. 29, 1934, p. 107-193.

Foord, A. H.: Catalogue of the Fossil Cephalopoda in the British Museum (Natural History). Part 1. London, 1888.

—————— Description of Fossils from the Kimberley District, Western Australia. *Geol. Mag.*, Dec., III., vol. 7, 1890, p. 2-20.

Goldfuss, G.: Naturhistorischer Atlas, vol. 4, 1832.

Gürich, G.: Jura- und Devon-Fossilien von White Cliffs, Australien. *Neues Jahrb. f. Min., Geol., Pal., Beil.-Bd.* 14. Stuttgart, 1901, p. 484-518.

Haug, E.: Traité de Géologie, vol. 2, fasc. 1, Paris, 1911.

Hill, D.: Upper Devonian Corals from Western Australia. *Jour. Roy. Soc. West. Australia*, vol. 22, Perth, 1936, p. 25-39.

Hoeninghaus, F. W.: Versuch einer geognostischen Eintheilung seiner Versteinerungs-Sammlung. *Jahrb. f. Min., Geogn., Geol. u. Petrefaktenk.*, vol. 1, Heidelberg, 1830.

Hosking, L. F. V.: Distribution of Devonian Rocks in the Kimberley Division; and Description of a Recent Collection of Devonian Fossils from the Kimberley Division. *Jour. Roy. Soc. West. Australia*, vol. 19, Perth, 1933, p. 67-76.

Kobayashi, T.: The Cambro-Ordovician Formations and Faunas of South Chosen. Palaeontology, Part I., Middle Ordovician. *Jour. Fac. Sci. Imp. Univ. Tokyo*, Sect. II., vol. 3, pt. 8, Tokyo, 1934, p. 335-519.

—————— On the Stereoplasmoceratidae. *Japan. Jour. Geol. Geogr.*, vol. 13, Tokyo, 1936, p. 229-242.

Martin, K.: Palaeozoische, mesozoische und känozoische Sedimente aus dem südwestlichen Neu-Guinea. *Samml. Geol. Reichs-Mus. Leiden*, Ser. I., vol. 9, Leiden, 1911, p. 84-107.

McCoy, F.: Prodromus of the Palaeontology of Victoria, Decade IV. *Geol. Surv. of Victoria*, Melbourne, 1876.

Miller, A. K.: Dunbar, C. O., and Condra, G. E.: The Nautiloid Cephalopods of the Pennsylvanian System of the Mid-Continent Region. *Nebraska Geol. Surv., Bull.* 9, 2nd ser., 1933.

Reed, F. R. C.: Palaeozoic and Mesozoic Fossils from Yun-Nan. *Mem. Geol. Surv. India, Palaeontol. Ind.*, N.S., vol. 10, no. 1, Calcutta, 1927.

Sandberger, G., and Sandberger, C. A. F.: Die Versteinerungen des Rheinischen Schichtensystems in Nassau. Wiesbaden, 1850-1855.

Schindewolf, O. H.: Bemerkungen zur Ontogenie der Actinoceren und Endoceren (Cephal., Nautil.). *Neues Jahr. Min., Geol., Pal. Beil.-Bd.* 74, Abt. B., Stuttgart, 1935, p. 89-113.

———— Paläozoische Ammonoidea. Fortschritte der Paläontologie, vol. 1, Berlin, 1937, p. 181-187.

Sowerby, J. de C.: Fossil Shells of the Lower Ludlow Age. In: R.C. Murchison, The Silurian System, Part II., London, 1839.

Stehn, Ch. E.: Devonische Fossilien von Holländisch-Neu-Guinea. *Dienst. Mijnb. Nederl. Indie, Wetensch. Meddedeel.*, no. 5, Weltevreden, 1927.

Sun, Y. C.: On the Occurrence of the Manticoceras Fauna in Central Hunan. *Bull. Geol. Soc. China*, vol. 15, Peiping, 1935, p. 249-252.

Teichert, C.: Nachweis paläozoischer Schichten von Südwest-Neu-Guinea. *Nova Guinea. Rés. Exp. Scient. Néerland. Nouv.-Guinée*, vol. 6, livr. 3, Leiden, 1928, p. 1-22.

———— Der Bau der actinoceroiden Cephalopoden. Palaeontographica, vol. 78, Abt. A., Stuttgart, 1933.

———— Untersuchungen an actinoceroiden Cephalopoden aus Nordgrönland. *Medd. om Grønland*, vol. 92, no. 10, Copenhagen, 1934.

Wade, A.: Petroleum Prospects. Kimberley District of Western Australia and Northern Territory. Melbourne, 1924. (The Parliament of the Commonwealth of Australia.)

———— The Geological Succession in the West Kimberley District of Western Australia. *Rep. 23rd Meet. Austral. N. Zeal. Ass. Adv. Sci.*, Wellington, N.Z., 1938, p. 93-96.

EXPLANATION OF PLATES.

Plate I.

Fig. 1.—*Conostichoceras hardmanni* (Etheridge). Lateral view of holotype. (Upper part strongly compressed.) Devonian. Lennard River, Kimberley District. 0.8 nat. size.

Figs. 2, 3.—*Wadeoceras australe* gen. nov. et sp. nov. Dorsal and lateral view of holotype. Upper Devonian. Mt. Pierre, Kimberley District. Nat. size.

Figs. 4, 5.—*Galtoceras kimberleyense* sp. nov. Lateral and ventral view of holotype. Upper Devonian. Mt. Pierre, Kimberley District. Nat. size.

Fig. 6.—*Stereoplasmoceras iniquiseptatum* sp. nov. Longitudinal median section of holotype. Devonian. Oscar Homestead, Kimberley District. Nat. size.

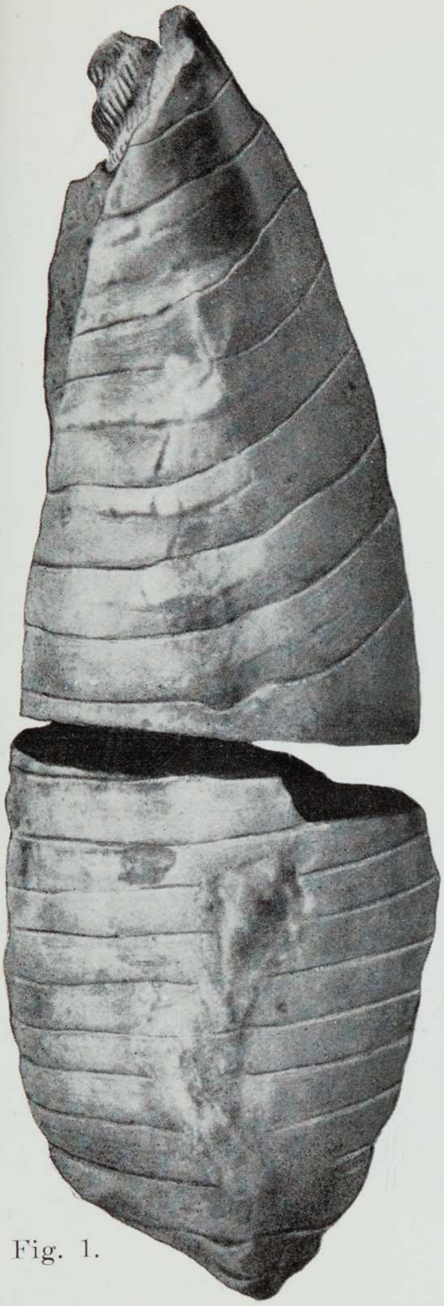


Fig. 1.

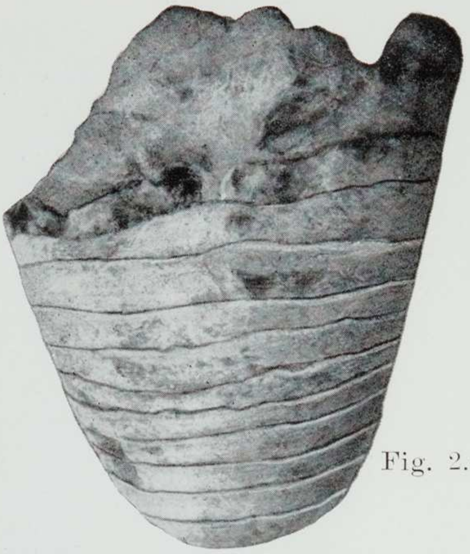


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

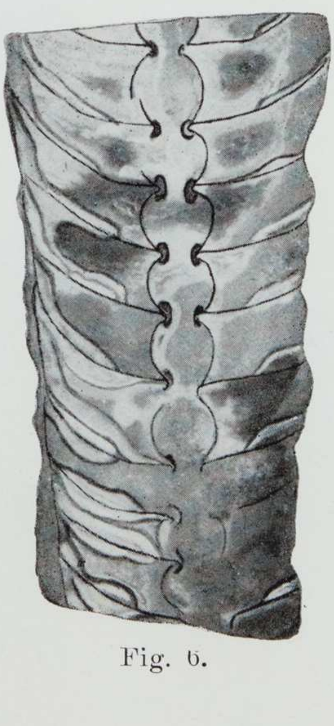


Fig. 6.

PLATE I.

Plate II.

Figs. 7, 8.—*Conostichoceras hardmanni* (Etheridge).

Fig. 7.—Ventral view of holotype (see Plate I., Fig. 1). 0.8 nat. size.

Fig. 8.—Cross-section of ventral part with siphuncle. 2.75 nat. size.

Fig. 7.

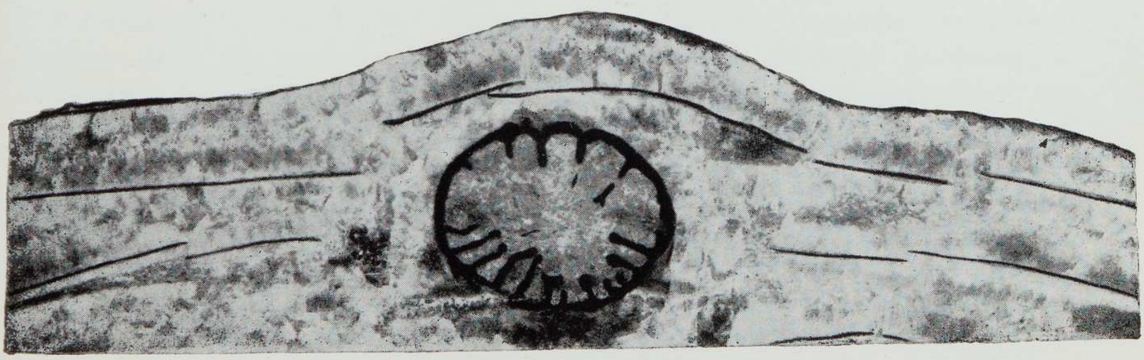


Fig. 8.

PLATE II.